



National Aeronautics and  
Space Administration

## Earth Science Research Plan

1/6/05 DRAFT



# Preface

This Research Plan is one of five documents that expand the broad strategy for Earth science within the U.S. National Aeronautics and Space Administration (NASA) into research, technology, data and information management, applications, and education. Prepared in consultation with NASA's Earth System Science and Applications Advisory Committee (ESSAAC) and with contributions by numerous investigators working at NASA centers, universities, and other institutions, this research plan updates and revises the Earth Science Enterprise Research Strategy published in December 2000.

Meant to define and explain Earth science research within NASA as part of the Agency's Earth Science Enterprise Strategy published in October 2003, this Research Plan was undergoing final revisions when in July 2004 NASA announced an agency-wide transformation that established a consolidated Science Mission Directorate with an Earth-Sun System Division. In its current version, the document provides a baseline and point of departure for further strategic planning within the Science Mission Directorate.

In keeping with a continuing commitment to Earth science through the 2004 transformation, one of NASA's newly stated objectives is to:

*Conduct a program of research and technology development to advance Earth observation from space, improve scientific understanding, and demonstrate new technologies with the potential to improve future operational systems.*

A strategic roadmapping effort within NASA is outlining multi-decadal pathways for each of the Agency's strategic objectives. In addition, NASA has asked the U.S. National Research Council to conduct a decadal survey of scientific priorities for Earth observations from space. This updated Research Plan describes the intellectual context and content of today's program and NASA's plans through the end of this decade. It thus provides a foundation on which the Agency roadmapping and NRC Decadal Survey efforts can plan for the decades beyond. As the products of those efforts will doubtless have implications for choices in this decade, NASA envisions an iterative relationship between those products and this document.





# NASA Earth Science Research Plan

1 Introduction . . . . .	1
1.1 NASA Earth Science Plans. . . . .	2
2 Approach to Earth System Science . . . . .	5
2.1 Research Focus Areas . . . . .	5
2.1.1 Climate Variability and Change . . . . .	9
2.1.2 Atmospheric Composition . . . . .	11
2.1.3 Carbon Cycle and Ecosystems . . . . .	13
2.1.4 Water and Energy Cycle. . . . .	15
2.1.5 Weather . . . . .	17
2.1.6 Earth Surface and Interior. . . . .	19
2.2 Observations . . . . .	21
2.2.1 Research and Development for Earth Observation Technology . . . . .	22
2.2.2 Satellite Missions . . . . .	22
2.2.3 Suborbital and Surface Observations . . . . .	24
2.2.4 Systematic Earth Observing Systems and Data Records . . . . .	25
2.3 Modeling, Analysis, and Prediction . . . . .	25
2.3.1 Exploring Interactions within the Earth System . . . . .	27
2.3.2 Distinguishing Natural from Human-Induced Change . . . . .	27
2.3.3 Understanding and Predicting the Consequences of Earth System Change . . . . .	29
2.3.4 Modeling Resources . . . . .	30
3 Resources . . . . .	33
3.1 NASA Research and Space Flight Centers . . . . .	33
3.2 Extramural Investigators. . . . .	33
3.3 High-Performance Computing . . . . .	34
3.4 Data and Information Systems . . . . .	35
4 Implementation . . . . .	36
4.1 Criteria for Evaluating Priorities. . . . .	36
4.1.1 Scientific Return. . . . .	37
4.1.2 Benefit to Society . . . . .	37
4.1.3 Mandated Programs. . . . .	37
4.1.4 Appropriate for NASA. . . . .	37
4.1.5 Partnership Opportunity . . . . .	38
4.1.6 Technology Readiness . . . . .	39
4.1.7 Program Balance . . . . .	39
4.1.8 Cost/Budget Context . . . . .	39
4.2 National and International Planning Coordination, and Collaboration . . . . .	39
5 Integration and Synthesis . . . . .	41
Appendices . . . . .	48



